

Claims

1. An apparatus for assisting in flying which comprises a flexible wing and a drive in which the wing is connected to the drive by a drive mechanism which oscillates or rotates the wing simultaneously about an axis and the axis is moved linearly back and forth and the combination of these two movements gives a flexing of the wing to produce lift.
2. An apparatus as claimed in claim 1 in which the drive is rotational or linear.
3. An apparatus as claimed in claim 1 or 2 in which the drive mechanism comprises (i) a support member attached to the flexible wing at a first mounting point on the wing (ii) a drive means able to impart a linear oscillation to the support member (iii) a second mounting point on the wing attached to the drive means spaced apart from the support member whereby when the drive mechanism operates the support member moves linearly and the wing flexes due to the relative motion of the support and the second mounting point to produce angular wing movement.
4. An apparatus as claimed in claim 3 in which the drive member comprises a rotatable offset cam mounted on a back plate at an angle to the back plate with the support member attached to a cam follower and the second mounting point attached to the back plate.
5. An apparatus as claimed in claim 4 in which the cam angle is adjustable.
6. An apparatus as claimed in any one of the preceding claims in which the drive mechanism incorporates a drive shaft connected to the axle of a drive member through a universal joint, the drive shaft and the axle of the drive member being at an angle to each other and there being a rotor connecting member mounted on the drive shaft which is connected to the drive member at one location.

- 19 -

- 5 7. An apparatus as claimed in any one of claims 3 to 6 in which the first mounting point is adjacent to the leading edge of the wing and the second mounting point is nearer the trailing edge of the wing and, in use the drive mechanism is configured so that, as the rotor rotates, the leading edge of the wing stays substantially at the front of the wing.
- 10 8. An apparatus as claimed in any one of the preceding claims in which the wing is articulated.
9. An apparatus as claimed in claim 8 in which the leading edge of the wing articulates separately from the rest of the wing.
- 15 10. An apparatus as claimed in claim 8 in which the wing articulates in three sections.
11. An apparatus as claimed in any one of the preceding claims 3 to 10 in which the support means is a rod or strut which is pivotally attached to the wing.
- 20 12. An apparatus as claimed in any one of claims 3 to 11 in which the wing at the first mounting point is attached to a wing shaft and the back part of the wing is also pivotally mounted along its length to the wing shaft via a connector and the trailing edge of the back part of the wing pivots up to 20 degrees (relative to the front part of the wing) around the wing shaft, and back again, while the wing shaft oscillates backwards and forwards on each full wing stroke.
- 25 13. An apparatus as claimed in claim 8 in which an articulating member is connected to the trailing edge of the back part of the wing, parallel to the wing shaft and a second member is pivotally connected to the free end of the first member and then connected to the back plate there being a circular offset cam mounted to the main

- 20 -

drive shaft and a half round (amplifier) cam mounted to the member connected to the back plate, facing inwards and rotatably fixed to the offset cam.

14. An apparatus as claimed in claim 13 in which, as the offset cam rotates, it causes the middle part of the cam follower member to rise and fall relative to the back plate and when the gap is opened to its widest point, the middle has a much larger gap than where the ends meet, the gap closing in a scissor like manner from corner to middle with the back end of the cam follower member and the edge of the side of the back plate as twin guide rails there being a small bus mounted to a rail via bearings, on the underside of the cam follower arm, and the side of the said portion of the back plate, the rail running the full length around the cam follower member and the said portion of the side of the back plate with the buses being free to move along the rail from end to end and are then pivotally hinged where one edge of one bus joins the other edge of the opposite bus.
15. An apparatus as claimed in any one of claims 3 to 14 in which the support member is a rod or strut which is pivotally attached along the wing.
16. An apparatus as claimed in any one of the preceding claims in which the drive mechanism is arranged such that the drive member follows a linear or generally rotary, preferably circular cyclic motion.
17. An apparatus as claimed in any one of the preceding claims in which the wing comprises a lightweight plastics or metal material which is secured to a frame.
18. An apparatus as claimed in any one of the preceding claims in which the drive comprises a linear motor.
19. An apparatus as claimed in any one of the preceding claims in which, by tuning the amplitude and the frequency of the oscillating and linear movements the wing can

- 21 -

be made to move so that only positive lift is generated and substantially no negative lift is generated at any stage.

20. An apparatus as claimed in claim 18 or 19 in which the wing is attached to a sleeve or collar mounted on an axle so that the oscillating motion is imparted by movement of the sleeve over the axle and the axle is moved linearly to generate the linear motion.
21. A flying device which incorporates at least two of the apparatus as claimed in any one of the preceding claims together with a motor which powers the drive
22. An apparatus as claimed in any one of claims 19 to 21 in which there is a common drive shaft which operates both the oscillating and the linear movements.
23. An apparatus as claimed in any one of claims 19 to 21 in which there are at least two wings driven by the same power source so that they flap together or in sequence.
24. An apparatus as claimed in claim 23 in which there are means to control the direction of flight by dipping one wing and raising the other.
25. An apparatus as claimed in claim 20 in which there are means to control the direction of flight by moving the wings sideways.
26. An apparatus as claimed in claim 23 or 25 in which the means to control the direction of flight by moving the wings comprises a control rod connected to the wings which control rod can be twisted and/or moved from side to side and/or back and forth.
27. An apparatus as claimed in any one of the preceding claims adapted for manipulating a multi articulating leg mechanism capable of emulating an insect walking gate in which the support member is attached to a first part of the leg

- 22 -

mechanism and the second mounting point attached to a second part of the articulating leg so that a walking motion is imparted to the leg.

28. An apparatus as claimed in any one of the preceding claims adapted for operating
5 underwater.